New, Patented Core NDE Technology

Material Characterization and Life Prediction for Critical Components Through the Application of Photon Induced Positron Annihilation (PIPA)

- Atomic lattice structure detection of damage
- Finds damage prior to crack nucleation
- Works on a wide variety of metals, alloys, composites and polymers
- Provides accurate estimates of remaining performance life
- Provides empirical data never before available

www.positronsystems.com

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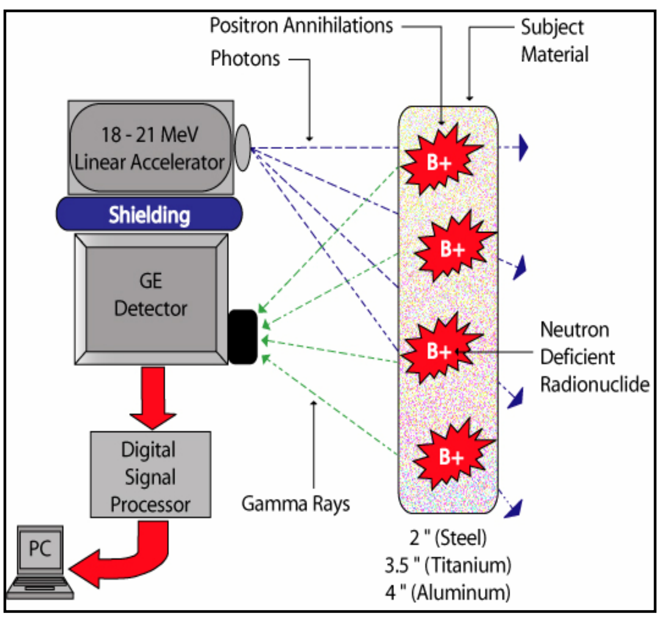
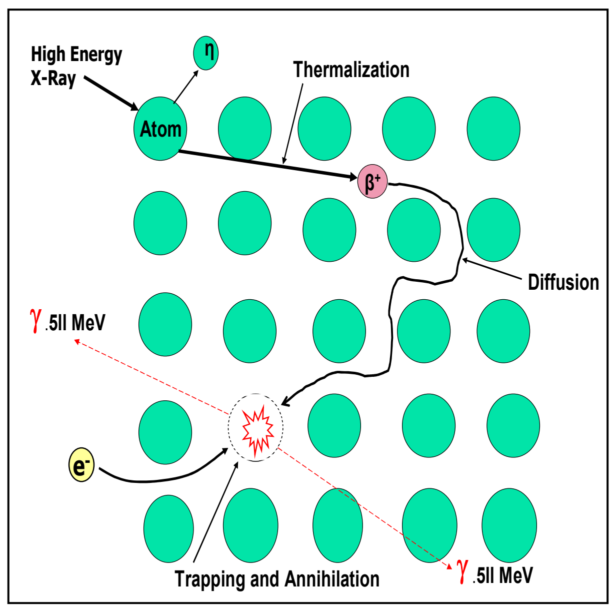
The PIPA Process





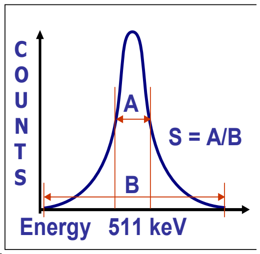
Key Principles of PIPA

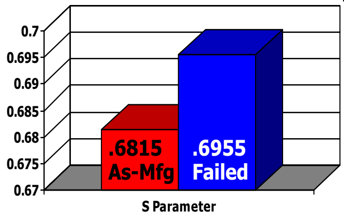
- Positive charge causes positrons to be repelled by protons so that they act as a microprobe
- “Attracted” to defect areas where atomic density is lower
- Defect areas contain higher ratio of low momentum electrons than non defect areas, thus annihilations approximate 511 keV or the “at rest” annihilation energy
- Lower atomic density in defect areas mean the positrons live longer
- Differences encountered in atomic structure provide different annihilation “fingerprints”

Results

Doppler Broadened S Parameter Analysis

- Counts within the 511 keV gamma ray energy level are compared against total counts
- The line shape parameter, "S", increases with number of defects
- Example S Parameters:





Case Study: Wing Spar 2nd Layer Crack Detection

Location	S Factor	Locations 1&3 Uncertainty	Location 2 Uncertainty
Location #1	.6815	.6818 $\pm$ .04%	
Location #2	.6820		
Location #3(Crack)	.6862		.6863 $\pm$ .02%
Location #3(Crack)	.6864		

Applications

Aerospace Vehicle Applications:

- WFD detection/investigations
- Engine parts fatigue/HCF detection
- Reduction in lifecycle testing
- Composite micro cracking/fatigue/void density determination
- Inclusion detection
- Residual stress issues
- Compressive stress impact
- Material characterization
- New materials research to improve power to weight ratio
- Life assessment and prediction modeling
- Maintenance specifications and life extension
- Failure analysis

Positron Systems' Solution:

- Identify high failure, critical components
- Conduct initial validation and feasibility assessment
- Direct examination program for critical components
- Develop failure model for evaluation and assessment
  - Empirical model for ongoing, operational assessments
- Develop in-situ systems for field environment
  - Improved surveillance and maintenance procedures

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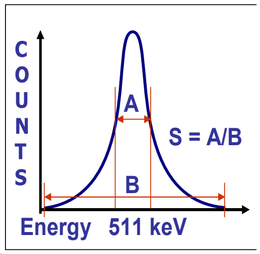
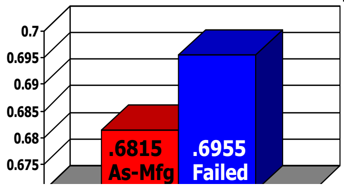
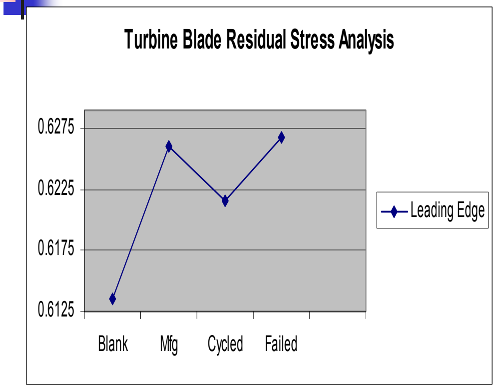




Turbine Engine Blade Residual Stress



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